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ABSTRACT

A study tested the long-term (end of Grade 1) effects of phonological skills treatment in kindergarten for children across a range of abilities. In Grade 1, 80 children from treatment and control classes participated in the study, along with 16 children in self-contained special education classes. In an earlier study with these same children, 6 kindergarten teachers in regular and special education classes were taught to conduct activities designed to stimulate their students' phonological manipulation skills such as blending and segmenting. Compared to controls, children with and without disabilities ended the year with significant treatment effects that transferred to measures of reading and writing. In the present study, for children without disabilities the early effects were no longer evident. Children from treated and control kindergartens gained in phonological, reading, and writing skills during Grade 1. For children with disabilities, the treatment continued to show significant effects on standardized measures of reading and writing, and on oral reading fluency and spelling. These long-term effects were found regardless of the setting (general or special education) in which children received kindergarten instruction. (Contains 3 tables of data and 38 references.) (Author/NKA)

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The Effect of Kindergarten Phonological Intervention on the First Grade Reading and Writing of Children with Mild Disabilities

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Abstract

In an earlier study (O'Connor, Notari-Syverson, & Vadasy, in press), we taught six kindergarten teachers in regular and special education classes to conduct activities with their children designed to stimulate phonological manipulation skills such as blending and segmenting. Compared to controls, children with and without disabilities ended the year with significant treatment effects that transferred to measures of reading and writing. The purpose of this study was to test the long-term (end of First Grade) effects of phonological skills treatment in kindergarten for children across a range of abilities. For children without disabilities, the early effects of treatment were no longer evident. Children from treated and control kindergartens gained in phonological, reading and writing skills during First Grade. For children with disabilities, the treatment continued to show significant effects on standardized measures of reading and writing, and on oral reading fluency and spelling. We found these long-term effects regardless of the setting (general or special education) in which they received kindergarten instruction.

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Over the past few years, we have been considering the possibility of improving the reading outcomes of children with mild disabilities by increasing their experience with phonological manipulation tasks in kindergarten. We explored the feasibility of teaching young children with disabilities to rhyme, blend and segment the sounds in words prior to formal reading instruction (O'Connor, Jenkins, Leicester, & Slocum, 1993); we tested whether economies might be gained by teaching blending prior to segmenting or vice versa (Slocum, O'Connor, & Jenkins, 1993); we considered the relative advantages to be gained by teaching minimal sets of tasks (i.e., blending and segmenting) or a more global array of phonological manipulations (O'Connor, Jenkins, & Slocum, 1995). During the past two years, we have taught teachers of kindergarten classes that included children with mild disabilities and other risk factors to use activities designed to increase the phonological skills of their children during large and small group instruction (O'Connor, Notari, & Vadasy, in press).

The Phonological Activities

Over the six month intervention in kindergarten, teachers learned to implement 25 activities that comprised the treatment. Activities in the first two months stimulated word and syllable awareness (e.g., teachers conducted finger point reading, labeled classroom materials, played syllable clapping games, made a chart of the day's activities, and wrote words and a morning message dictated by children). Activities in months three and four stimulated rhyming, first sound isolation, and onset-rime level blending and segmenting. Children played *Guess My Word* ("I'm thinking of an animal: sn--ake"), matched rhyming pictures in card decks, and touched Elkonin boxes (Elkonin, 1973) as they said words in onset-rime format. In the last two months, we added letter sounds to phonological activities (e.g., "Find the letter that starts *Max*"); showed children how to use a letter sound to match pictures that start with the same sound; and made the auditory blending and segmenting games more sophisticated by separating each spoken phoneme.

Children with Mild Disabilities and Literacy Opportunities in Kindergarten

Studies that compared opportunity to learn about reading in special education and general education kindergartens have reported fewer opportunities in special education classrooms for children with mild disabilities to learn the skills related to literacy, such as isolation of the first sound in words, letter names and sounds, and writing, and for discussions surrounding read aloud time (Koppenhaver, 1993). Miranda (1994) suggests teachers of children with disabilities may place a lower priority on reading and experiences with print than teachers in general education kindergartens, although Katims (1991) reported improvement in print concepts for children with mild-to-moderate disabilities at the close of a year in a literacy-enriched kindergarten.

The children during the implementation year of the current study attended three kinds of kindergartens: integrated general education that included 2-3 children with mild disabilities, transition classes for children repeating the kindergarten year, and self-contained classes for children with mild mental retardation (MMR), learning disabilities (LD), or behavioral disorders (BD). We selected control classes in the same school district from similar neighborhoods and class compositions for the regular and transition classes; however, children in the self-contained special education classes had no control group because the school district had no other similar classes. All classes used the same prereading kindergarten curriculum (Macmillan), which included instruction in letter names, association of letter sounds with a picture that started with target sound, tracing of letters, and listening to and discussing Big Books (oversized, display editions of stories for young children). We were most interested in the integrated kindergartens, because we wanted to discover whether children with various kinds of learning difficulties would respond differentially to group instruction in phonological skills.

During the months of intervention, we monitored the activities and their frequency of use in each of the participating classes. Among our sample, teachers of self-contained classes implemented more phonological activities than teachers in the regular classes, although the area of greatest difference was found in the lowest level of phonological tasks, particularly syllabication

and rhyming games. Table 1 lists the activities and shows the range of implementation of each type of activity in each type of class. Teachers implemented a minimum of 100 activities during the 90-day treatment. Because of differences in the number of activities used by teachers of self-contained and integrated classes, we also wanted to discover whether long-term outcomes differed for children with mild disabilities who received the treatment in different settings.

Growth in phonological skills. While kindergarten training studies report difficulty in phonological skill acquisition for children with lower than average ability (O'Connor et al., 1993; Torgesen, Morgan, & Davis, 1992), studies in First Grade sometimes report relatively more growth in these skills for initially low-skilled children (Lie, 1991; Torneus, 1984). Our work in kindergarten has found larger gains for children with average or high ability (as measured by pretests of receptive vocabulary and letter knowledge), however, none of the categories of mild disability appeared to preclude growth in blending and segmenting; that is, some children in each category made strong blending and segmenting gains. The largest and most consistent gains during the intervention year were made by treated children repeating kindergarten, although it is important to recall that these children were also, on average, a year older than other kindergartners. Children with disabilities or repeating kindergarten in the control classes also gained blending and segmenting skill during kindergarten, although these gains were significantly smaller than those of children in treated classes.

Findings from the First Year

The short term results of this work (reported in O'Connor et al., in press) suggest that general class teachers can increase the phonological skills of their children with and without disabilities through whole class and center-based activities, and that doing so yields significant gains in reading and writing over children who were not specifically taught to blend and segment spoken words. Other studies have reported similar findings (Ball & Blachman, 1991; Byrne & Fielding-Barnsley, 1993; Cunningham, 1990), however, our study differed along two

dimensions: First, teachers (not research personnel) conducted the phonological activities with their children; and second, classes included children with mild disabilities. The following study reports Second Year (end of First Grade) outcomes for children who received kindergarten intervention.

Method

Participants and Procedure

During the kindergarten year, participating children were enrolled in three kinds of kindergartens in a large urban school district: regular (which included a few students with mild disabilities), transition (for children repeating the kindergarten year), and self-contained classes for children with mild disabilities (MR, LD, or BD). The ethnic distribution in the school district was 52% African American, 46% Caucasian, and 2% other, and these classes reflected a similar distribution, except for the transition classes, in which approximately 65% of children were African-American. All schools with participating classes represented similar neighborhood income levels and ethnic composition. Information about the training of kindergarten teachers, fidelity of implementation, and the response of low-skilled children to the activities is reported elsewhere (O'Connor et al., in press).

At the end of First Grade, we located 80 of the 90 children from the original treatment and control classes, and 16 of the 17 children in the self-contained special education kindergartens. Because appropriate controls did not exist for children in the self-contained special education classes, we considered their phonological and reading growth apart from the treatment/control comparisons. All except one of the children from the self-contained kindergartens remained in self-contained special education classes in First Grade. Of children with disabilities served in integrated kindergartens, all but two were served in integrated First Grades. The two exceptions, one from treated, and one from control classes, moved to self-contained special education settings.

Of the ten children we could not locate, 7 were from transition classes (four and three from experimental and control conditions, respectively). This was also the group with the greatest

proportion of attrition during the kindergarten year. Children from transition classes who remained in the district through First Grade participated in regular first grade classes, so we included their scores in the means reported for the regular first grade children. Tabled scores reflect only students who remained through the end of the First Grade year. Descriptive statistics are shown in Table 2.

Reading instruction in First Grade. From the original six integrated classes, children dispersed across nine First Grade classes in six schools. All First Grade classes used the district-adopted Macmillan series (1993) for reading instruction, except for one child who moved to a private school. First grade materials begin with a collection of six Big Books constructed of high-frequency, relatively irregular words. Although a phonic generalization is taught for each book (e.g., -ot in Down by the Bay; -ick in Chick and Duckling, which are the first two books), each has only one word in the book to which the generalization applies. Activities throughout the first grade materials encourage deriving meaning, predicting events, and using picture cues. Phonological awareness is not emphasized, except for recognizing and generating rhyme.

Most children who repeated kindergarten during the intervention year received 20-30 minutes of small group supplemental assistance through Chapter 1 services in First Grade. These groups also used the Macmillan texts, but offered additional read aloud and discussion time. All but two of the children with disabilities placed in regular first grade classes (both from treated kindergartens) received additional reading instruction provided by either a special educator or remedial teacher. The remedial teachers used Macmillan materials, however, some of the special educators used additional materials, such as alternative highly decodable texts, or practice cards for letter/sound or word reading practice. These groups met two-to-four times weekly, and a similar range of conditions were found for children from experimental and control classes.

Measures

Kindergarten measures. To describe our sample, we administered the Peabody Picture Vocabulary Test-Revised (PPVT-R; Dunn & Dunn, 1981), a sound repetition task, and a one-minute timed test of letter naming. We also administered several measures of phonological manipulation skill: isolation of the first sound in spoken words, tests of blending and segmenting three-phoneme words, and producing rhymes. These measures are described, along with testing items, in O'Connor et al. (1995). To assess literacy development, we administered the letter-word

identification and dictation subtests of the Woodcock-Johnson Tests of Achievement (WJ: Woodcock & Johnson, 1990) during the pretest and posttest phases.

First Grade measures. In May of First Grade, a graduate student unfamiliar with the First Year study readministered individually the letter-word identification and dictation subtests of the WJ, along with the word attack subtest, to all students. In a second round, she administered a timed test of auditory segmentation, a test of oral reading fluency (words read correctly in one minute on a primer level passage) and the predictable words portion of the Test of Written Spelling-2 (TWS: Larsen & Hammill, 1986). Means and standard deviations for these measures are reported in Table 2.

Results

We included only children who remained in the school district at the end of First Grade, and who were available at all three data collection periods in these analyses. Although several children left the area (see Participants), the pattern of kindergarten results mirrors those in the earlier study (O'Connor et al., in press).

First we considered the short- and long-term treatment effects for children without disabilities by conducting analyses of covariance (using the appropriate pretest score) on measures collected at the end of kindergarten following treatment, and one year later at the end of First Grade. Separating analyses for children with and without disabilities permits comparison of our results to other studies of treatment effects for typically developing children. Next, we conducted analyses of outcomes for the children with mild disabilities who were taught in integrated kindergartens. Children in the self-contained special education classes in kindergarten, who had no control group, were not included in these analyses, although we show the means and standard deviations from their test scores alongside those of other participants in Table 2 for comparison.

Effects of Treatment for Children without Disabilities

Short-term effects. Analyses of covariance at the end of kindergarten revealed no significant differences on descriptive measures (PPVT-R and sound repetition), or on tasks that tapped instructional activities conducted in experimental and control classrooms (letter naming and rhyme production). Treated children at the end of Kindergarten scored significantly higher than the control children on blending and segmenting spoken words, and on the WJ test of letter-word identification. Inspection of the posttest means suggests that ceiling effects were likely on the measures of first sound and rhyme, except for the children with disabilities. Test statistics for all comparisons are shown in Table 3.

Long-term effects. We conducted similar analyses of covariance for the end of First Grade measures for children without disabilities, using both pretests from the WJ as covariates for the measures of word attack, oral reading fluency, and spelling, which were only administered at the end of First Grade. None of these analyses revealed significant long-term treatment effects; thus, the early differences between groups of children developing typically were no longer evident.

Effects of Treatment for Children with Disabilities

Short-term effects. Children with disabilities showed a similar pattern of results. At the end of kindergarten, we found no significant treatment effects on scores from the descriptive measures (the PPVT-R, sound repetition, and rapid letter naming tasks), or on rhyme production or first sound isolation. Treated children outperformed their controls, however, on the phonological tasks targeted by the treatment--blending and segmenting--and on the standardized scores from the WJ letter-word identification and dictation subtests.

Long term effects. At the end of First Grade, the treated children with disabilities continued to score significantly higher than untreated children on standardized measures of word identification and dictation, and also on word attack and spelling; However, the groups did not differ significantly on oral reading fluency, or on the timed segmentation measure.

Comparison of long-term outcomes by placement. To test whether outcomes for children treated in the self-contained special education kindergartens differed from outcomes for children with disabilities treated in integrated kindergartens, we conducted one-way analyses of covariance (by pretest score) for each first grade measure. None of these tests showed significant differences for treatment setting.

Although treated children with disabilities improved more than untreated children, initial differences between children with disabilities and their peers without disabilities maintained at all three times of testing. The treatment did not raise their reading to the level of their nondisabled peers.

Discussion

The purpose of this study was to test the long-term (end of First Grade) effects of phonological skills treatment in kindergarten for children across a range of abilities. For children without disabilities, the early effects of treatment dissipated by the end of First Grade, as children in treated and control classrooms gained in phonological, reading, and writing skills. For children with disabilities, the significant end-of-treatment differences were still evident at the end of First Grade on standardized measures of reading and writing, and on spelling.

Different Patterns of Effects for Children with and without Disabilities

Other studies that trained typically developing children to perform phonological manipulation tasks have reported minimal, if any, effect on reading one year later (Byrne & Fielding-Barnsley, 1993; Lie, 1991; Lundberg et al., 1988). Our sample of children without disabilities--despite significant gains following treatment--failed to read and spell at significantly higher levels than similar children without kindergarten intervention in phonological skills. The reason for this lack of long-term effect may lie in the growth of reading for these children during First Grade, which probably stimulated phonological awareness to sufficiently high levels to enable reading development among control, as well as treated children (Foorman, Francis, Novy,

& Liberman, 1991; Perfetti et al., 1987). An examination of scatterplots from the end of kindergarten suggests that children who already read words prior to formal reading instruction segment at least some sounds beyond the first sound in spoken words. Stahl and Murray (1994) and O'Connor et al. (in press) also note this phenomenon.

Children with disabilities, who often read poorly compared to their typically developing peers, have fewer opportunities to independently develop segmentation at these advanced levels. For these children, providing early assistance in apprehending the sounds that comprise words may offer a necessary and sustained advantage in the earliest stages of reading development. Increasing phonological awareness in kindergarten may have contributed to their ability to make sense of reading instruction in First Grade; thus, making optimal use of the instruction they received. Because all of the children in this study received the same general approach and reading materials in First Grade (due to the recent district adoption of the Macmillan series and the accompanying district-sponsored inservice), it becomes plausible that the observed differences at the end of First Grade were due to preparation for instruction, rather than to differences in beginning reading instruction.

These findings support Juel's (1986) conclusion that children need to develop phonological skills very early in First Grade for it to contribute to reading development. For the children with disabilities in this study, attaining segmentation by the end of First Grade--as apparently occurred for children in the control classrooms--was too late to provide the sense-making possibilities attributed to facility with segmentation. At the end of the year, then, we cannot attribute improved outcomes to differences in segmentation that persisted through First Grade, as differences did not persist. It would be instructionally useful to identify whether a critical time for the attainment of specific phonological skills exists in relation to reading development. The issues of when and how higher levels of segmentation and blending affect reading for children with disabilities remains unresolved. Taking several measures through First Grade over time might help to answer these questions.

Limitations

Several factors flaw the findings we report here. First, the increasing standard scores for most children in this study on the WJ subtests may be an artifact of the measure, which has few items at the K-1 levels. We tried to offset this possibility by including a broader range of literacy measures (i.e., fluency and spelling) in First Grade. Second, small sample sizes and lack of random assignment limit the generalizability of our results. Third, the treatment was administered to intact classroom groupings; therefore, the more robust analysis would use teacher as the unit of analysis. We are currently addressing the last two concerns by attempting to replicate this project with a larger (N=360) sample of children.

A Last Word

Stanovich (1986) argues that children who learn to read easily and on time continue to benefit from the good things reading provides: better vocabulary, quicker recognition of words, easier comprehension. These abilities encourage children to read more, thus yielding an ever increasing spiral of ability--what Stanovich terms a "bootstrapping effect." Children who struggle with reading acquisition may experience "the cascade of interacting achievement failures and motivational problems" (p. 393) that depress not only reading, but other academic areas influenced by reading.

Of course, many factors affect reading development. Vocabulary knowledge and language skills influence reading acquisition (Bowey & Patel, 1988; Wagner, Torgesen, Laughon, Simmons, & Rashotte, 1993), and our children with disabilities began the study nearly two standard deviations below the typically developing children on a measure of receptive vocabulary. Phonological training is expected to assist with reading acquisition, and may be a necessary prerequisite (Juel et al., 1986; Tunmer, Herriman, & Nesdale, 1988; Share & Stanovich, 1995). Nevertheless, this suggestion is troublesome because classes for young children with disabilities may spend less time on skills prerequisite to reading (phonological manipulation skills and letter

knowledge) than do classes for children who are likely to have less trouble with reading acquisition. We learned through end-of-kindergarten interviews with teachers in our self-contained classes that they spent considerably more time during the intervention year on letter naming than in previous years, and that the blending and segmenting activities they conducted were entirely new. General education teachers in treated classes reported spending about the same amount of time on letter naming in kindergarten, but much more time than usual on blending and segmenting.

Letter knowledge at the end of kindergarten was significantly lower for children with disabilities who were integrated into these same general kindergarten classes. It appears that children with disabilities may require more practice or greater opportunities to learn about letters than their typically developing peers, and that inaccurate or inefficient letter knowledge at the end of Kindergarten may inhibit reading growth for the children with disabilities, who were comparable at the end of kindergarten to untreated typically developing children in phonological skills.

Early indications suggest that kindergarten stimulation of phonological skills may provide assistance during that initial year of reading instruction, such that children one would expect to have severe reading acquisition problems acquire rudimentary skills more readily than anticipated. Children without disabilities learned to blend and segment in kindergarten more readily than their peers with disabilities; Moreover, most children without disabilities learn to read in First Grade regardless of kindergarten intervention. Although it is more difficult to teach phonological manipulation skills to children with disabilities (e.g., classroom observations confirmed that it takes more practice, requires more careful monitoring of participation, and more scaffolding to support participation), doing so for these children appears to have a more longer lasting impact on reading acquisition than for typical achievers.

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Table 1

Types of Activities and Frequencies of Use, by Class Type.

	Range of Implementation in Each Class Type		
Types of Activities	Regular K (n = 2)	Transition K (n = 1)	Special Ed (n = 2)
Low-level Skills	range 9-27	18	range 62-63
Clap syllables			
Rhyming pictures			
Describing items			
Nursery rhymes			
Blending & Segmenting	range 51-53	85	range 52-88
First sound			
Blend, segment onset-rime			
First/last sound			
Blending phonemes			
Elkonin boxes (3)			
First sound song			
Who knows a word...			
Books and Writing	range 36-51	67	range 73-129
Fill in the Blanks			
Morning Message; I Found			
Finger-point reading			
Making Books			
Post Office			
Blend/segment book words			
Total Activities Implemented	range 100-131	172	range 189-281

Table 2
Means and Standard Deviations for Experimental and Control Groups

	Children without Disabilities		Children with Disabilities		
			Integrated in General K		Self-contained
	Treatment	Control	Treatment	Control	Kindergarten
	n = 42	n = 24	n = 7	n = 7	n = 16
Age at Pretest	5.5 (0.4)	5.6 (0.4)	6.0 (0.9)	6.3 (0.8)	5.3 (1.5)
Pretests in Kindergarten					
PPVT-R	100.8 (14.1)	99.7 (15.2)	71.9 (8.6)	71.7 (6.4)	73.9 (12.7)
Sound Repetition (12)	8.2 (2.0)	9.1 (1.7)	5.6 (1.3)	6.9 (1.5)	4.4 (1.9)
Letter naming	32.9 (15.9)	29.6 (15.1)	4.4 (3.4)	11.4 (9.2)	13.8 (14.6)
Blending (20)	4.2 (3.7)	4.1 (3.1)	1.4 (2.7)	1.8 (1.4)	0.2 (0.5)
First sound (10)	6.4 (3.1)	7.3 (3.2)	1.6 (3.0)	3.4 (2.4)	0.4 (1.5)
Segmenting (30)	6.3 (5.8)	6.2 (3.5)	0 (0)	3.6 (2.5)	0 (0)
Rhyming (10)	3.8 (1.7)	4.1 (1.5)	1.5 (2.4)	2.1 (1.6)	0.1 (0.5)
WJ Dictation[a]	103.6 (13.2)	103.2 (6.9)	68.7 (20.8)	78.0 (28.5)	80.6 (22.8)
WJ Letter-word id[b]	102.0 (11.1)	98.5 (12.4)	73.1 (16.9)	74.3 (14.7)	85.2 (14.3)
Posttests, May of Kindergarten					
PPVT-R	104.9 (14.1)	100.2 (16.1)	76.7 (12.3)	74.6 (6.1)	80.2 (11.3)
Sound repetition (12)	10.0 (1.2)	10.0 (1.6)	7.7 (2.3)	9.7 (1.3)	7.3 (2.7)
Letter naming	42.1 (13.1)	35.7 (15.4)	21.4 (14.0)	23.0 (11.8)	33.5 (17.1)
Blending (20)	15.6 (5.3)	11.2 (6.9)	9.7 (7.4)	3.6 (3.7)	7.9 (6.3)
First sound (10)	9.4 (1.5)	8.9 (2.8)	6.7 (3.8)	7.4 (3.4)	7.1 (3.0)
Segmenting (30)	23.8 (7.9)	9.5 (5.8)	11.6 (10.9)	8.4 (4.0)	15.6 (9.8)
Rhyming (10)	9.3 (1.6)	9.1 (2.4)	5.7 (4.8)	8.2 (1.7)	4.8 (4.5)
WJ Dictation[a]	106.5 (11.0)	98.3 (11.2)	90.0 (12.5)	77.9 (10.9)	98.3 (16.7)
WJ Letter-word id[b]	102.8 (11.2)	96.1 (10.3)	85.6 (10.6)	73.3 (12.6)	96.8 (17.2)
Follow-up Measures, First Grade					
	Treatment	Control	Treatment	Control	Self-contained
WJ Letter-word id	114.9 (14.8)	109.8 (17.0)	92.2 (12.4)	82.0 (10.6)	96.1 (16.2)
WJ Dictation	109.5 (14.1)	105.1 (17.3)	91.2 (10.1)	87.3 (4.9)	93.7 (12.7)
WJ Word attack	118.4 (13.0)	108.9 (14.3)	90.6 (8.4)	82.4 (5.2)	96.7 (14.4)
Segmentation[c]	31.4 (12.4)	27.5 (8.5)	20.3 (15.8)	16.6 (13.4)	19.3 (15.9)
Fluency	66.7 (35.5)	42.5 (29.0)	24.0 (6.3)	9.9 (13.2)	28.7 (36.6)
TWS[d]	11.3 (5.8)	9.0 (5.8)	5.6 (2.6)	2.0 (1.7)	4.0 (4.1)

NOTE: Numbers in parentheses refer to maximum possible scores.

[a] Standard scores by age (Mean = 100; SD = 15) on the dictation subtest of the Woodcock-Johnson Tests of Achievement.

[b] Standard scores by age (Mean = 100; SD = 15) on the letter-word identification subtest of the Woodcock-Johnson Tests of Achievement

[c] Segmentation: Number of correctly segmented phonemes in one minute

[d] Test of Written Spelling: Words spelled correctly

Table 3

Test Statistics: Short- and Long-term Effects of Treatment , Covaried for Pretest

	Children without Disabilities			Children with Disabilities		
Short-term effects[a]	*MSe*	F(1,63)	*p*	*MSe*	F(1,11)	*p*
PPVT-R	185.35	2.42	.12	26.53	0.18	.68
Sound repetition	1.85	0.02	.90	2.02	1.00	.34
Letter naming	102.36	3.79	.06	101.20	1.46	.26
Rhyme	2.49	1.08	.30	5.23	0.01	.92
First sound	2.77	4.55	.04	7.93	2.09	.18
Blending	22.69	11.26	<.01	13.16	23.40	<.01
Segmenting	44.01	59.24	<.01	48.61	5.16	.05
WJ letter-word	45.58	14.94	<.01	44.74	19.80	<.01
WJ dictation	74.59	12.07	<.01	60.89	8.08	.02
Long-term effects[b]						
Segmentation	117.83	1.30	.26	218.31	0.03	.88
WJ letter-word	150.14	0.11	.75	75.39	5.40	.04
WJ dictation	187.28	1.26	.27	34.77	6.98	.02
WJ attack	138.34	2.67	.11	49.26	8.19	.02
Fluency	794.62	3.66	.06	159.48	4.07	.08
Spelling	24.40	0.90	.35	5.81	7.71	.02

[a] End of Kindergarten Measures

[b] End of First Grade Measures